

GEOCHEMICAL CHANGES IN SIDERITES FROM THE LUBLIN COAL BASIN – PRELIMINARY RESULTS

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Siderite samples were collected from the Lublin Beds (Westphalian B) in the “Bogdanka” coal mine the Lublin Coal Basin (LCB). The LCB forms an elongated NW–SE depression split by the Kock Structure into two major regions – the asymmetric Radzyń–Bogdanka Syncline and the Stoczek–Dorohucza Syncline (ZDANOWSKI, 1999). Fresh-water and brackish environments are characteristic of the LCB sedimentation. The Westphalian B sediments enclose coal seams intercalated by sandstones, mudstones, claystones and occasionally limestones and siderites (CEBULAK, 1988).

Siderites occur in every type of sedimentary rocks and are differ in their size, shape and form of occurrence. Small siderite concretions, siderite ooids and siderite layers from the sandstones, mudstones and claystones were chosen to examination.

X-ray powder diffractometry (XRD) analyses were carried out at the Department of Mineralogy, Petrography and Geochemistry, AGH – University of Science and Technology (AGH-UST), Krakow, using a Philips X’Pert diffractometer with a graphite monochromator under the following operating conditions: CuK_α radiation, scanning speed $0.02^\circ(2\theta)/\text{sec}$, range $3\text{--}73^\circ 2\theta$.

Distribution of Fe, Mg, Mn and Ca within siderites and the chemical composition of associated minerals were determined with a cold field emission scanning electron microscope (FESEM) Hitachi S-4700 coupled with an energy dispersive spectrometer (EDS) NORAN Vantage at the Institute of Geological Sciences of the Jagiellonian University, Kraków.

The results indicate the presence of clay minerals (mainly kaolinite and illite), quartz, sometimes feldspars and siderite in the samples studied. Siderite XRD peak positions are shifted in comparison to those of pure siderite. It might be a result of isomorphic substitution of Mg^{2+} , Mn^{2+} or Ca^{2+} in the siderite structure. SEM investigations point to the presence of sulphides (pyrite, sphalerite), quartz and carbonate minerals (ferroan dolomite, calcite and siderite). Sphalerite, pyrite, calcite and ferroan dolomite are present in septarian cracks, while siderite, pyrite, quartz and clay minerals are common in the concretion bodies themselves.

High variability of isomorphic substitutions of Mg, Mn and Ca for Fe was observed in the analysed siderite samples. The inner parts of siderites are relatively purer and have less isomorphic substitutions than the outer ones. The purest inner parts of siderites (oolites up to 98.61 wt%, concretions up to 94.17 wt%, siderite layers up to 96.27 wt% of FeCO_3) are

characteristic of the early stage of siderite formation. The highest value of Mg is characteristic of the outer parts of siderite bodies and suggests the late diagenetic (or even epigenetic) origin of these parts of siderites. Higher content of Mg (up to 35.42 wt% of MgCO_3) than that of Mn (up to 10.85 wt% of MnCO_3) or Ca (up to 9.34 wt% of CaCO_3) was calculated. Compositions corresponding to sideroplesite or even pistomesite (in accordance with the peak shifts observed in the XRD patterns) were recorded. Despite the fact that oolites are purer than the other types of siderite (up to 98.61 wt% FeCO_3), the characteristic evolution from highest values of Fe in the inner parts of the oolites to highest values of Mg (up to 22.91 wt% of MgCO_3), Ca (up to 4.89 wt% of CaCO_3) and Mn (up to 2.81 wt% of MnCO_3) in the outer parts of the oolites is also observed. The chemical composition of siderite cements in the sandstones and mudstones is similar to that of the late type of siderite present in the outer parts of concretions (up to 37.28 wt% of MgCO_3 ; up to 5.94 wt% of MnCO_3 ; up to 6.95 wt% of CaCO_3).

Mg, Mn and Ca isomorphic substitutions for Fe and chemical evolution were observed in siderites from all types of sedimentary rocks of the Lublin Beds but there were only small quantitative differences among them.

Evolution of chemical compositions in the analysed siderite samples has been proven. Similar changes were indicated in sediments from other regions by previous authors (e.g. MIDDLETON & NELSON, 1996; MOZLEY, 1989).

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References

- CEBULAK, S. (1988): Prace Instytutu Geologicznego, 72: 77–88.
- MIDDLETON, H.A. & NELSON, C.S. (1996): Sedimentary Geology, 103: 93–115.
- MOZLEY, P.S. (1989): Geology, 17: 704–706.
- ZDANOWSKI, A. (1999): Geological atlas of the Lublin Coal Basin 1:50 000. Warszawa: Państwowy Instytut Geologiczny. (in Polish and in English)